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Yield and Quality of some Sugar Beet Varieties as Affected by Humic Acid Application Rates under Sandy Soil Condition

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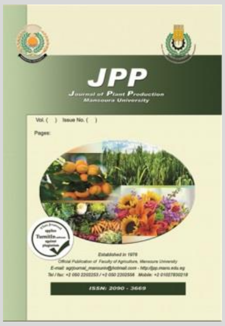

ABSTRACT

A field experiment was conducted at privet farm of Demo (29° 17` N, 30° 53` E), Fayoum Governorate, Egypt, during 2018/2019 and 2019/2020 to study the effect of three humic acid treatments, i.e. (0 without humic acid as control, 3.5 and 7 Kg humic acid/fed) on quality and yield traits of eight sugar beet varieties (Santolhne, Pepite, Amina, Beta 401, Dina, Grinta, Sirona and Bts 302). Results indicated that root yield (ton/fed) was increased by increasing the rates of humic acid from 3.5 to 7kg per fed in the first season (27.02 and 29.11 ton/fed, respectively), corresponding (28.08 and 29.72 ton/fed in the second season respectively). Similarly, the content of molasses forming substances showed more reduction in 3.5 than in 7kg/fed treatment. Nevertheless, the trend of increasing content of sucrose and refined sugar was associated with humic acid rates. Results showed that varieties significantly differed among them where, Sirona variety show the superiority over the other seven tested varieties and recorded the highest values of root diameter (14.19 and 15.14 cm, respectively), fresh root weights/plant (1.41 and 1.47 kg, respectively), in both seasons, as well as root yield/fed (29.94) in 2nd season. While, in first season variety (Bts 302) registered the highest values of root yield (29.42 ton/fed), also this variety recorded the highest sugar yield (4.62 and 5.23 ton/fed, respectively) in both seasons. Highly significant interaction effects between humic acid and varieties root yield and sugar yield and their related traits in both seasons. it could be concluded that fertilization with humic acid at a rate of 7kg /fed as a soil application to get the maximum of root and sugar yields/fed in sandy soil.

Keywords: Sandy soil, Sugar beet, Sugar quality, Humic acid, Growth traits

INTRODUCTION

Nowadays sugar beet (*Beta vulgaris*, L.) considered an important source of sugar production in Egypt. The importance of this crop comes from its growing in the newly reclaimed land and giving a high sugar recovery. Also, sugar beet is often, the most important cash crop. The production of sugar from sugar beet reached 58.9% (1.27 Million tons) of sugar production in Egypt corresponding, 41.1% (0.931 Million tons) from sugarcane, according to Council of sugar crops (2020).

Sandy soils are described as low fertility and low holding water capacity (Goa *et al.,* 1998). Sandy soils in Demo village may be considered as one of the enabling areas for agricultural expansion but many hydrological problems are facing the area of reclamation. Expanding sugar beet cultivation on newly reclaimed lands should hardly be pushed to increase the sugar crop sector, thereby increasing local sugar production. To obtain maximum yield from the promising area listed, evaluation and selection of suitable varieties are required. Limited rainfall and low soil fertility have reduced crop productivity in arid and semi-arid environments including Egypt, especially sugar beet crops. Proper soil and correct cultivar selection affect crop productivity and soil sustainability (Benlhabib *et al.,* 2014). Humic acid is a soil conditioner formulated to increase the ability of soil to retain nutrients and improve water-holding capacity. Humic enhances the soil's ability to chelate nutrients and to promote the exchange of nutrients between plants and the fertilizers being applied. Additionally, crop management technologies such as fertilization policies are required to improve crop production and maintain soil fertility under the effects of climate change. Humic acid is assumed that under sandy and saline soils, humic acid improves the growth and yield of sugar beet and increases the uptake of nutrients as a result (Rahimi *et al.*,2020). Therefore, humic acids are commonly used as a soil supplement in agriculture. However, they contain complexes form and ions that are commonly found in the environment creating humic colloids. Rassam *et al.*, (2015) studied the effect of using the humic acid in calcareous soil at concentrations, no application (zero) humic acid, 2.5 l/ ha and 5 l/ha., the application of humic acid caused a significant increase of sucrose%, root yield and refined sugar yield and a reduction in molasses as compared to the control treatment. Humic acid (HA) is the main component of humic substances, which are the major soil organic constituents (humus). It is produced by biodegradation of organic matter. Humic acid is not a single acid; rather, it is a complex mixture of various acids containing carboxyl and phenolate groups. Humus substances (humic and fulvic acids) constitute 65-70% of organic matter in soils and the term humus is widely accepted as synonymous with soil organic matter (Chen and Aviad, 1990). EL-Hassanin *at el.*, (2016) reported that the application of humic acid increased root and sugar yield of sugar beet varieties. The objectives of the present work were to evaluate the performance of eight sugar beet varieties and their response to different levels of soil application with humic acid on growth, yield, and quality of sugar beet in a low fertile sandy soil condition.

MATERIALS AND METHODS

Afield experiment was conducted at privet farm of Demo (29° 17` N, 30° 53` E), Fayoum, Egypt, in two successive of 2018/2019 and 2019/2020 to study the effect of three humic acid rates, i.e.(0 without humic acid as control, 3.5

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and 7 Kg humic acid/fed) on quality and yield traits of eight sugar beet varieties (Santolhne, Pepite, Amina, Beta 401, Dina, Grinta, Sirona and Bts 302) which obtained from Sugar Crop Research Institute Agricultural Research Center, Giza. The experimental design was a split-plot design in three replicates. Solid humic acid contains are (PH 7%, humic acid 75%, potassium oxide (K_2O) 10%, volvic acid 4%, and Fe 2% w/v), also it is a soluble content. The humic treatment is soil application by spraying the ground around the sugar beet plants. Humic acid levels were randomly assigned to the main plot once after thinning (after thirty days from sowing), and the second dose one month later, while sugar beet varieties were distributed in the subplot. Nitrogen was applied as urea (46.5% N) in three equal doses, one third before the first irrigation after thinning directly and the second and third ones were applied at 65 and 85 days after planting. Further, calcium superphosphate (15.5% P_2O_5) at a rate of 100 kg/fed. Was applied during land preparation. The plot area was 10.5 m^2 (1/400 fed) containing 5 rows of 3.5 m length (60 cm between rows and 25 cm between plants). Sugar beets varieties in the first and second seasons were sown on September 25th and 30th, respectively. The plants were thinned into two plants per hill after 30 days and singled to one plant per hill after 45 days from sowing. All other agricultural practices were done as recommended. Soil physical and chemical properties of the experimental site were determined according to Page (1982) as shown in (Table 1).

Table 1. Some physical and chemical properties of the soil before planting during two seasons

Practical size distribution%		2018/2019			
		Soluble cations (meq/L)		Available macronutrients (mg/kg)	
Sand%	74.12	Ca++	15.17	N	14.43
Silt%	11.35	Mg++	7.22	P	3.25
Clay%	14.53	Na+	14.36	K	1.51
Textural class	Sandy	K+	0.75	Available micronutrients (mg/kg)	
pH	7.2	Soluble Anions (meq/ L)		Fe	3.88
EC(ds/m)	3.18	HCO_3-	2.14	Mn	1.49
O.M (%)	0.69	CL-	21.20	Zn	0.71
CaCO3 (%)	1.69	SO4	14.16	Cu	0.62
		2019/2020			
		Soluble cations (meq/L)		Available macronutrients (mg/kg)	
Sand%	71	Ca++	13.42	N	18.66
Silt%	12.8	Mg++	8.54	P	5.47
Clay%	16.2	Na+	13.42	K	1.75
Textural class	Sandy	K+	2.21	Available micronutrients (mg/kg)	
pH	7.67	Soluble Anions (meq/ L)		Fe	4.14
EC(ds/m)	2.65	HCO3-	2.14	Mn	2.31
O.M%	1.22	CL-	20.3	Zn	1.02
CaCO3%	2.03	SO4	15.16	Cu	0.89

At harvest (210 days from sowing), the three guarded rows of each subplot were harvested, cleaned, topped and weighed and the following characteristics were determined in both seasons at Al-Fayoum sugar company laboratories (sucrose%, extractable sugar (%), potassium (%), α-amino nitrogen (%), and sodium (%). However, vegetative growth traits, i.e. root length (cm), root diameter (cm), and root fresh weight/plant (kg) were estimated from random five plants for each treatment. Data collected were statistically analyzed according to Gomez and Gomez (1984) by using SAS computer software package. L.S.D at 5% level was used to compare the means according to Waller and Duncan (1969). Yield of clean roots were determined from the three guarded rows for each treatment, meanwhile sugar yield was estimated according the following equation: sugar yield (ton/fed) = Root yield ton /fed × Extractable sugar%

RESULTS AND DISCUSSION

Performance of sugar beet varieties

1.Productivity traits

Results presented in Table (2) indicated significant differences in root length, root diameter, root weight as well as root yield (ton/fed) among sugar beet varieties in both seasons. Sirona and Bts302 varieties recorded the highest values of all the above-mentioned traits in the two seasons. Bts302 and Sirona varieties surpassed the other sugar beet varieties in root yield (29.42 and 27.09 ton/fed) in the 1st corresponding (29.89 and 29.94 ton /fed) in the 2nd season. as well as the lowest root yield registered by variety (Pepite) (23.73 and 25.12 ton /fed) in both seasons. The differences among the studied sugar beet varieties could be due to the gene makeup and their response to the environmental condition. Varieties differences in root parameters were also recorded by Abu-Ellail *et al.,* (2019) and Abd El-Aal *et al.,* (2010) who found highly significant differences among cultivars in the root weight of sugar beet.

2.Quality traits

Results illustrated in Table (2) indicated significant differences in sucrose%, extractable sugar%, and sugar yield (ton/fed) among sugar beet varieties, however, the differences between varieties did not reach the level of significance with respect to sugar lost to molasses % (SLM%). Bts 302 variety recorded the lowest SLM% values at both seasons (1.60 and 1.63 %, respectively). It could be noted that Bts 302 variety attained the highest values of sucrose%, extractable sugar%, and sugar yield, this results due to the lowest values of SLM % for this variety. The variations among the tested sugar beet varieties in these traits might be due to the gene make-up action, which plays an important role in plant structure and morphology. Rahmi *et al.,* (2020) and Fuentes *at el.,* (2018) showed that significant differences among sugar beet varieties for sucrose and refined sugar yield affected by humic acid application compared to the control treatment.

3.Impurities traits

Results demonstrated in Table (2) appeared significant differences between the studied varieties with respect to their contents from the different impurities such as N%, Na%, and K%. Sugar beet variety Bts 302 recorded the lowest values of impurities compared to other varieties. This observation may be explaining the superiority of this variety with respect to sugar yield. Low impurities, SLM%, and high sucrose% lead to high sugar extraction consequently high sugar yield. This results almost due to gen action which affected juice quality. This finding is in line with Abu-Ellail *et al.,* (2019) Nemeata Alla *et al.,* (2018) who found that significant differences among sugar beet varieties in impurities components (potassium, sodium, and alpha amino-N) that decreased significantly influenced by humic in both seasons.

Table 2. Means of productivity, quality traits and impurities traits of eight sugar beet varieties as affected by humic acid during two 2018/2019 and 2019/2020 seasons

Varieties	2018/2019										
	Productivity traits				Quality traits				Impurities traits		
	RL	RD	RW	RY	SLM%	S%	ES%	SY	N%	Na%	K%
Santolhne	33.22	12.34	1.02	25.05	1.72	18.47	16.15	4.05	1.24	2.36	4.15
Pepite	32.56	12.42	0.97	23.73	1.75	18.29	16.13	4.04	1.34	2.44	4.06
Amina	31.72	13.89	0.95	26.25	1.79	16.61	15.91	3.77	1.36	2.51	4.24
Beta 401	32.36	12.16	0.92	27.07	1.68	18.56	14.33	3.76	1.25	2.15	4.07
Dina	34.89	11.88	1.09	28.05	1.75	18.68	16.21	4.39	1.29	2.41	4.25
Grinta	34.44	13.82	1.31	25.84	1.77	18.51	16.31	4.58	1.32	2.46	4.23
Sirona	33.67	14.19	1.41	27.09	1.76	19.24	16.15	4.17	1.33	2.43	4.17
Bts 302	35.96	13.8	1.17	29.42	1.60	19.84	17.04	4.62	1.12	1.96	3.89
LSD at 0.5%	0.55	021	0.10	1.22	NS	0.22	0.05	0.02	NS	NS	NS
	2019/2020										
Santolhne	34.61	13.32	1.05	26.04	1.75	18.96	16.61	4.32	1.32	2.42	4.18
Pepite	34.17	13.11	1.02	25.12	1.75	18.32	16.61	4.32	1.38	2.35	4.14
Amina	33.84	13.05	1.01	25.59	1.80	18.31	15.92	4.00	1.38	2.50	4.33
Beta 401	35.77	12.88	0.99	27.78	1.83	18.99	15.88	4.06	1.33	2.33	4.81
Dina	35.68	12.87	1.13	27.08	1.79	19.56	16.60	4.61	1.36	2.43	4.35
Grinta	36.49	13.78	1.41	29.15	1.79	18.77	17.17	4.65	1.36	2.52	4.30
Sirona	35.21	15.14	1.47	29.94	1.81	19.70	16.36	4.77	1.43	2.49	4.28
Bts 302	37.20	13.99	1.22	29.89	1.63	20.09	17.47	5.23	1.21	2.00	3.92
LSD at 0.5%	0.30	NS	0.10	0.65	NS	0.26	0.34	0.10	NS	NS	NS

RL= Root length, RD =Root diameter, RW= Root weight, RY=Root yield, SLM=Sugar lost in molasses, S=Sucrose, ES= Extractable sugar, SY=Sugar yield, N= α-amino nitrogen %, Na= Sodium and K=Potassium

Effect of humic acid on root yield and related traits

1.Productivity traits

Results obtained in Table (3) showed that increasing humic acid (HA) rates from 0 up to 7 kg /fed increased significantly root length and root diameter (cm) during the 2018/2019 and 2019/2020 seasons. The highest mean values were obtained by adding the highest application rate of humic acid (7 kg /fed). On the contrary, the lowest mean values were obtained by growing sugar beet plants under control treatment. Meanwhile, there was a significant increase in root yield (ton/fed) of sugar beet plants as a result of increasing humic acid rates from zero up to 7 kg / fed. The direct act of humic acid on plant growth is as increasing the cell chlorophyll content, hormonal growth responses, the respiration process acceleration, in-plant membranes increasing substances penetration, dry matter production changing, and nutrients uptake. These results are in harmony with those obtained by Rassam *et al.,* (2015) and Türkmen *et al.,* (2004) who reported that HA application positively affected the parameters of plants grown in stress conditions. Peizzeghello *et al.,* (2013) indicated that the humic acid enhances the plant growth may be due to the increasing cell membrane permeability, respiration, photosynthesis, oxygen, and phosphorus uptake and supplying root cell growth.

Table 3. Means of productivity, quality traits and impurities traits of eight sugar beet varieties as affected by humic acid during two 2018/2019 and 2019/2020 seasons

Humic acid rats	2018/2019										
	Productivity traits				Quality traits				Impurities traits		
	RL	RD	RW	RY	SLM%	S%	ES%	SY	N%	Na%	K%
Zero (H1)	30.07	11.64	0.89	23.56	2.04	16.13	13.49	3.18	1.68	3.42	4.56
3.5kg/ fed (H2)	34.10	13.22	1.05	27.02	1.78	18.91	16.53	4.47	1.41	2.34	4.29
7kg/ fed (H2)	36.64	14.33	1.37	29.11	1.36	20.53	18.57	5.40	0.76	1.26	3.55
LSD at 0.5%	1.15	1.23	0.11	2.13	0.33	1.42	1.21	0.13	0.61	0.97	0.23
	2019/2020										
Zero (H1)	32.03	12.26	0.92	24.91	2.06	17.35	14.69	3.66	1.73	3.47	4.6
3.5kg/ fed (H2)	36.24	13.47	1.12	28.08	1.82	19.16	16.74	4.70	1.5	2.38	4.39
7kg/ fed (H2)	37.84	14.82	1.45	29.72	1.39	20.75	18.76	5.57	0.81	1.29	3.64
LSD at 0.5%	1.57	1.06	0.10	2.04	0.51	1.32	0.98	0.21	0.56	0.88	0.19

RL= Root length, RD =Root diameter, RW= Root weight, RY=Root yield, SLM=Sugar lost in molasses, S=Sucrose, ES= Extractable sugar, SY=Sugar yield, N=Alpha amino nitrogen, Na= Sodium and K=Potassium

2.Quality traits

Soil applications of humic acid revealed a significant increase in sucrose%, extractable sugar, and sugar yield (ton/fed), however, SLM% was decreased, as compared with the control treatment in both seasons as shown in Table (3). In general, 7 kg/fed of humic acid treatment caused the best growth performance followed by 3.5 kg/fed of humic acid treatments in both seasons of study. Applying humic acid was accompanied by an increase in the values of sucrose and refined sugar percentages compared with the control treatment. The trend of an increase in sucrose content and extractable sugar was associated with the humic acid rate in all applications from 3.5 to 7 kg/fed. This result could be expected due to the decrease of impurities i.e., (K, Na, and N) in the juice. These results are in agreement with those obtained by Motaghi and Nejad (2014) and Shaban *et al.,* (2014) who reported that quality traits of sugar beet were significantly increased by increasing the rate of humic acid. Mehdi *et al.,* (2013) reported that the sugar yield of sugar beet varieties was strongly increased by increase humic acid rates compared with untreated plant.

3.Impuries traits

Results illustrated in Table (3) recorded that increasing humic acid from zero up to 7 kg/fed decreased significantly the total N, Na, and K percentages during 2018/2019 and 2019/2020 seasons, where the highest mean values of N% (1.68 and 1.73 %), Na%(3.42 and 3.47%) and K% (4.56 and 4.6%) with control. However, the lowest mean values of N% (0.76 and 0.81 %), Na% (1.26 and 1.29 %), and K% (3.55 and 3.64%) were obtained under 7kg humic/fed during the first and second seasons, respectively. Also, it could be observed that the response of juice impurities tended to be similar to the effect of humic acid on juice quality when increasing the applied dose of humic acid up to 7 kg /fed recorded the highest value of juice quality. These results may be due to humic acid in balance which to makes oil properties improvement which affected the studied parameters. These results are in agreement with those obtained by Motaghi and Nejad (2014) and Shaban *et al.,* (2014) who reported that quality traits of sugar beet were significantly increased by increasing the rate of humic acid. Rahimi *et al.,* (2020) indicated that humic acid application enhances quality parameters of sugar beet.

Interaction effect between varieties and humic acid rates

1.Productivity traits

Data in Table (4) show that the interaction between the tested sugar beet varieties and soil application of humic acid rates was significantly affected in root yield, root length, root diameter, root weight, and root yield in the two seasons. When plant treated with 3.5Kg humic acid/fed, the sugar beet variety (Dina) recorded the highest values of root length (36.11 and 37.4 cm, respectively) in both seasons. However, when the plant treated with 7Kg humic acid/fed, the variety (Bts302) registered the highest significant value of root length (39.30 and 40.2 cm, respectively) in both seasons. Furthermore, variety (Amina) gave the highest root diameter with treated of 3.5 and 7 kg humic acid/fed (14.40 and 15.77cm, respectively) in the first season, followed by variety (Sirona) in the second season with treated by 3.5 and 7 kg humic acid/fed (15.20 and 16.1 cm, respectively). Variety (Grinta) registered the biggest root weight (1.68 kg) in the first season followed by Sirona variety (1.74 kg) in the second season when treated by 7 kg humic acid/fed. While variety (Bts 302) recorded the highest root yield in the first season (31.65 ton/fed) and second season (32 ton/fed) when treated by 7 kg humic acid/fed. Said-AlAlh and Hussein, (2010) who found that the humic acid application led to an increase in growth parameters compared with control due to the effect of humic acid on solubilization and uptake of nutrients. The significant interaction between tested sugar beet varieties and humic for root and quality traits in both seasons, had been reported by Enan *et al.,* (2016) who found the treated with 10-liter humic acid/fed recorded the highest significant root traits values. Also, they added that the interaction between sugar beet varieties and humic acid had a significant effect on root and sugar yields in both seasons.

Table 4. Interaction effect between sugar beet varieties and humic acid fertilizer on productivity traits during 2018/2019 and 2019/2020 seasons.

Varieties	Root length			Root diameter			Root weight			Root yield		
	Humic acid rates											
	0	3.5Kg	7 Kg	0	3.5Kg	7 Kg	0	3.5Kg	7 Kg	0	3.5Kg	7 Kg
2018/ 2019												
Santolhne	29.92	33.77	35.96	10.88	12.77	13.37	0.86	0.95	1.24	21.03	25.20	28.93
Pepite	27.59	34.03	36.06	11.47	12.93	12.87	0.72	0.90	1.29	20.59	24.05	26.55
Amina	28.06	31.97	35.13	11.50	14.40	15.77	0.72	0.90	1.24	21.29	26.69	30.76
Beta 401	28.59	32.73	35.76	10.50	12.57	13.40	0.70	0.88	1.19	23.76	27.81	29.63
Dina	31.52	36.11	37.03	9.80	12.23	13.60	0.85	1.03	1.40	25.80	28.40	29.94
Grinta	32.02	34.43	36.86	13.23	13.47	14.77	1.05	1.19	1.68	23.94	26.31	27.28
Sirona	30.19	33.83	37.00	13.27	13.57	15.73	1.25	1.48	1.49	25.23	27.90	28.15
Bts 302	32.66	35.93	39.30	12.50	13.79	15.11	1.00	1.08	1.42	26.80	29.80	31.65
2019/ 2020												
Santolhne	31.40	35.70	36.60	11.40	13.80	14.60	0.83	0.98	1.33	21.18	27.10	29.00
Pepite	30.40	34.90	37.10	11.70	13.00	14.50	0.77	0.93	1.37	22.70	25.50	27.00
Amina	29.90	35.50	36.00	11.30	12.70	15.10	0.71	0.99	1.33	21.80	26.70	28.10
Beta 401	31.90	36.40	38.90	11.80	12.60	14.10	0.74	0.98	1.25	23.90	28.60	30.70
Dina	31.70	37.40	37.80	12.20	12.60	13.70	0.81	1.10	1.49	25.70	27.20	28.20
Grinta	33.60	36.90	38.80	12.60	13.80	14.90	1.04	1.59	1.61	27.20	29.10	31.00
Sirona	32.80	35.70	37.00	13.90	15.20	16.10	1.31	1.37	1.74	28.40	30.10	31.30
Bts 302	34.10	37.10	40.20	12.80	13.70	15.30	1.14	1.05	1.46	27.50	30.00	32.00
LSD at 0.5%			0.78			0.31			0.05			1.03

2.Quality traits

Results in Table 5 indicated that the interaction between varieties and humic acid levels was significantly affected in sucrose, extractable sugar percentages, and sugar yield in the two seasons. Plant treated with 7Kg humic acid/fed, sugar beet variety (Bts 302) recorded the highest values of sucrose% (22.1 and 21.9 %,) and extractable sugar% (20.25 and 19.99 %) and the highest sugar yield (6.41 and 6.40 ton/fed) in first and second seasons, respectively compared with over the other tested ones. It seems that an increase in humic acid application in terms of amount and frequency is positively related to the content of sucrose and refined sugar in the root. Lee and Bartlett (1976) and David *et al.,* (1994) reported that the utilization of humic acid reduced the impurities in juice. Hozayn (2013) found significant differences among the tested cultivars in all studied characters of sugar beet grown under newly reclaimed soil when treated by humic acid.

3.Impurities traits

Results accessible in Table (6) indicated that the interaction between the evaluated sugar beet varieties and humic acid levels was significantly affected in impurities in terms of N% and Na% in both seasons. Variety (Bts 302) gave the lowest N and Na percentages with treated of 3.5 and

7 kg humic acid/fed in the first season (1.26 and 0.62 %, respectively) and (1.83 and 1.08 %), also this variety recorded the highest in second seasons under treatment 3.5kg humic acid/fed (1.33 and 1.82%, respectively) and 7kg humic acid/fed (0.77 and 1.15 %, respectively) compared by the zero humic acid treatment. Impurities are decreased positively related to increasing humic acid rates. This result may be due to the effect of humic acid on sodium, potassium, and α-amino nitrogen percentages in beets root. Shaban *et al.*, (2014) indicated that the addition of 10 kg humic acid/fed as a soil application significantly increased, N, P, and K percentages in sugar beet root in both seasons. Olk *et al.*, (2018) and El-Sayed *et al.*, (2019), who revealed that increasing humic acid made up a decrease in sodium, potassium, and amino nitrogen contents of sugar beet varieties up to 300 kg. $ha.^{-1}$

Table 5. Interaction effect between sugar beet varieties and humic acid fertilizer on quality traits during 2018/2019 and 2019/2020 seasons.

Varieties	SLM%			Sucrose %			Extractable sugar %			Sugar yield		
	Humic acid rates											
	0	**3.5Kg**	**7 Kg**	**0**	**3.5Kg**	**7 Kg**	**0**	**3.5Kg**	**7 Kg**	**0**	**3.5Kg**	**7 Kg**
2018/ 2019												
Santolhne	2.03	1.79	1.34	15.40	18.80	21.00	12.77	16.41	19.06	2.68	4.14	5.51
Pepite	2.08	1.79	1.37	15.70	19.20	19.90	13.02	16.81	17.93	2.68	4.04	4.76
Amina	2.11	1.87	1.37	15.00	17.10	17.60	12.29	14.63	15.63	2.62	3.90	4.81
Beta 401	1.97	1.73	1.36	16.70	18.00	20.90	14.13	15.67	18.94	3.36	4.36	5.61
Dina	2.07	1.78	1.41	15.70	19.50	20.80	13.03	17.12	18.79	3.36	4.86	5.63
Grinta	2.07	1.82	1.41	16.20	18.50	20.60	13.53	16.08	18.59	3.24	4.23	5.07
Sirona	2.07	1.81	1.39	17.10	19.50	21.10	14.43	17.09	19.11	3.64	4.77	5.38
Bts 302	1.89	1.65	1.25	16.90	20.30	22.10	14.41	18.05	20.25	3.86	5.38	6.41
2019/ 2020												
Santolhne	2.08	1.81	1.38	16.90	19.00	20.90	14.22	16.59	18.92	3.01	4.50	5.49
Pepite	2.11	1.78	1.38	19.80	17.50	20.00	17.09	15.12	18.02	3.88	3.86	4.87
Amina	2.12	1.91	1.37	20.20	16.00	18.90	17.48	13.49	16.93	3.81	3.60	4.76
Beta 401	2.02	1.83	1.39	21.30	17.90	18.80	18.68	15.47	16.81	4.47	4.42	5.16
Dina	2.09	1.84	1.43	20.90	17.40	19.90	18.21	14.96	17.87	4.68	4.07	5.04
Grinta	2.11	1.85	1.43	16.30	18.90	18.90	13.59	16.45	16.87	3.70	4.79	5.23
Sirona	2.09	1.88	1.44	18.50	19.90	20.60	15.81	17.42	18.56	4.49	5.24	5.81
Bts 302	1.91	1.67	1.31	18.10	20.10	21.90	15.59	17.83	19.99	4.29	5.35	6.40
LSD at 0.5%			NS			1.01			0.57			0.03

Table 6. Interaction effect between sugar beet varieties and humic acid fertilizer on impurities traits during 2018/2019 and 2019/2020 seasons.

Varieties	N%			Na%			K%		
	Humic acid rates								
	0	**3.5Kg**	**7 Kg**	**0**	**3.5Kg**	**7 Kg**	**0**	**3.5Kg**	**7 Kg**
2018/ 2019									
Santolhne	1.68	1.40	0.64	3.46	2.40	1.23	4.49	4.31	3.64
Pepite	1.77	1.51	0.73	3.57	2.45	1.30	4.55	4.06	3.58
Amina	1.73	1.51	0.85	3.66	2.56	1.32	4.77	4.56	3.38
Beta 401	1.72	1.37	0.68	3.09	2.11	1.26	4.34	4.24	3.64
Dina	1.65	1.39	0.83	3.54	2.41	1.29	4.74	4.28	3.72
Grinta	1.67	1.41	0.88	3.47	2.58	1.33	4.76	4.31	3.62
Sirona	1.73	1.43	0.83	3.60	2.41	1.27	4.51	4.41	3.59
Bts 302	1.48	1.26	0.62	2.96	1.83	1.08	4.35	4.14	3.19
2019/ 2020									
Santolhne	1.77	1.49	0.70	3.48	2.48	1.30	4.61	4.21	3.71
Pepite	1.79	1.59	0.78	3.62	2.21	1.23	4.65	4.10	3.66
Amina	1.73	1.57	0.83	3.66	2.55	1.28	4.83	4.70	3.46
Beta 401	1.74	1.52	0.74	3.28	2.40	1.31	4.44	4.38	3.72
Dina	1.71	1.50	0.86	3.52	2.46	1.30	4.76	4.46	3.83
Grinta	1.75	1.45	0.88	3.65	2.56	1.35	4.71	4.47	3.71
Sirona	1.85	1.52	0.90	3.54	2.55	1.36	4.50	4.61	3.73
Bts 302	1.51	1.33	0.77	3.04	1.82	1.15	4.34	4.18	3.26
LSD at 0.5%			0.04			0.07			NS

CONCLUSION

The results concluded that humic acid application enhances juice quality and root yield traits. The treated with a humic acid rate of 7kg/fed gave the highest juice quality and lowest impurities. Sugar beet varieties responded positively to humic application. It is suggested that there is a great potential of humic acid use in sugar beet to produce high roots and quality for economical sugar production under the sandy soil.

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إنتاجية وجودة بعض أصناف بنجر السكر التي تأثرت بمعدلات استخدام حمض الهيوميك تحت ظروف التربة الرملية

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أجريت التجربة الحقلية بمزرعة خاصة (29 ° 17` شمالاً ، 30 ° 53` شرقاً) بمحافظة الفيوم ، مصر خلال موسمى 2019/2018 و 2020/2019 لدراسة تأثير ثلاث معاملات من حمض الهيوميك (0 بدون الهيوميك ، 3.5 و 7 كجم حامض الهيوميك / فدان) على صفات الجودة والإنتاجية لثمانية أصناف من بنجر السكر (Santolhne ، Pepite، Amina، Beta 401 ، Dina، Grinta، Sirona و302 Bts) أشارت النتائج إلى زيادة محصول الجذر (طن / فدان) بزيادة معدلات حمض الهيوميك من 3.5 إلى 7 كجم للفدان في الموسم الأول (27.02 و 29.11 طن / فدان على التوالي) ، مقابل (28.08 و 29.72 طن / فدان في الموسم الثاني على التوالي). أظهر محتوى المواد السكرية المفقودة فى المولاس انخفاضًا نتيجة المعاملة بالهيومك وكذلك أدى إلى زيادة محتوى السكروز والسكر المكرر بزيادة معدلات حمض الهيومك. أظهرت النتائج أن الأصناف اختلفت بشكل كبير فيما بينها حيث أظهر صنف (Sirona) تفوقاً على الأصناف السبعة الأخرى المختبرة وسجل أعلى قيم لقطر الجذر (14.19 و 15.14 سم على التوالي) ووزن الجذور الطازجة لكل نبات (1.41 و 1.47 كجم على التوالي) في كلا الموسمين. وسجل كذلك الصنف (Sirona) أعلى حاصل الجذور للفدان (29.94 طن للفدان) في الموسم الثاني، بينما سجل الصنف (Bts 302) أعلى حاصل للجذور(29.42 طن للفدان) فى الموسم الاول وسجل أيضا أعلى قيم لمحصول السكر (5.12 و 5.19 طن / فدان على التوالي) في الموسمين. أظهرت النتائج تأثيرات تفاعلية معنوية عالية بين حمض الهيوميك ومحصول جذر الأصناف ومحصول السكر والصفات المرتبطة بها في كلا الموسمين. يمكن الاستنتاج أن التسميد بحمض الهيوميك بمعدل 7 كجم / فدان كتطبيق في التربة للحصول على أقصى قدر من محصول الجذور والسكر / فدان في التربة الرملية.

الكلمات المفتاحية: التربة الرملية ، بنجر السكر ، جودة السكر ، حمض الهيوميك ، معدل النمو